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The Evolution and Decline of the Ancient Chinese Practice of Watching for the Ethers

Huang Yi-Long and Chang Chih-ch'eng

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* * *

The Development of the Practice of Watching for the Ethers in Ancient China

Hou-ch'i 候氣 (watching for the ethers) was a method used to calculate the seasons.[1] It embodied the ancient Chinese concept of the unity of Heaven, Earth and Man. The practice of hou-ch'i involved burying

[1] Previous research on hou-ch'i is very scanty—Derk Bodde's is the only article to treat the subject. See Bodde, "The Chinese Cosmic Magic Known as Watching for the Ethers," in Søren Egerod and Else Glahn (eds.), *Studia Serica Bernhard Karlgren Dedicata, Sinological Studies Dedicated to Bernhard Karlgren on his Seventieth Birthday, October Fifth, 1959* (Copenhagen: Ejnar Munksgaard, 1959), pp. 14–35. Bodde's major contribution appears in his discussion of hou-ch'i as it was practiced before the Ming. The present article, however, will focus on the debate over hou-ch'i during the Ming and Ch'ing periods.

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twelve musical pitchpipes of graduated lengths in a sealed chamber, and filling the pipes with ashes produced by burning the pith of a reed (*Phragmites communis, var. longivalvis*).[2] The ancients believed that when the sun entered the second fortnightly period of any given month (*chung-ch'i* 中氣), the earth's *ch'i* 氣 (seminal force) would rise and expel the ashes from the pipes.

Among those who have studied the history of Chinese musical harmonics and calendar-making, the hou-ch'i practice has long been a controversial topic. This has been a result of the difficulty of integrating the practice with the results of actual calculations. Though the practice appeared at least as early as the time of Ching Fang 京房 (79–37 B.C.) of the Western Han dynasty (206 B.C.–8 A.D.), detailed descriptions of its operation are few. The few examples include Ts'ai Yung's 蔡邕 (133–92) *Yueh-ling chang-chü* 月令章句 (Punctuated commentary on the monthly ordinances),[3] Ssu-ma Piao's 司馬彪 *Hsü Han chih* 續漢志 (Sequel to the records of the Han), written during the Chin 晉 dynasty (265–420), and Li Ch'un-feng's 李淳風 *Lü li chih* 律曆志 (Monograph on musical harmonics and the calendar), which appeared in the *History of the Sui Dynasty*, written in the T'ang.[4] According to these documents, very few people were successful in practicing hou-ch'i. Hsin-tu Fang 信都芳 of the Northern Ch'i dynasty (551–77) was one of the exceptions.[5]

In the history of the hou-ch'i practice, Hsin-tu Fang and his "wondrous method" played an important role.

> He knew how to use pitchpipes to watch for the ethers and observed the appearance of the clouds. Once, while conversing, he pointed to the sky and said, "The fortnightly period of the early spring has arrived." His interlocutor thereupon checked the pitchpipes, only to discover that the ashes had already flown free. [Hsin-tu's] monthly calculations were always correct. He made a wheel of twenty-four fans and buried it so as to predict the twenty-four fortnightly periods. With the arrival of each fortnightly period, a single fan moved while all the

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[2] The twelve musical pitchpipes of traditional China were the six *yang lü* 陽律 (*huang-chung* 黃鐘, *t'ai-ts'u* 太蔟, *ku-hsien* 姑洗, *jui-pin* 蕤賓, *i-tse* 夷則, and *wu-yeh* 無射) and six *yin lü* 陰呂 (*ta-lü* 大呂, *chia-chung* 夾鐘, *chung-lü* 中呂, *lin-chung* 林鐘, *nan-lü* 南呂, and *ying-chung* 應鐘). The length of each pipe is determined by the so-called *san-fen sun-i-fa* 三分損益法 (the method of one-third decrease and increase). By reducing the length of a pitchpipe of known length and pitch by one third, one produces a pitchpipe five tones higher. By increasing the original pitchpipe's length by one third, one produces a pitchpipe three tones lower.

[3] Bodde, "The Chinese Cosmic Magic," pp. 18–19.

[4] *Hou Han-shu* 後漢書 [The history of the eastern Han dynasty] (Peking: Chung-hua shu-chü, 1975), pp. 3015–16; *Sui-shu* 隋書 [The history of the Sui dynasty] (Peking: Chung-hua shu-chü, 1975), pp. 394–97.

[5] *Sui-shu*, pp. 394–97.

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others remained immobile. This method duplicated the results obtained by pitchpipes and ash.[6]

According to this text, Hsin-tu not only employed the traditional pitchpipe method, he also employed a system of twenty-four "mechanical fans" to verify the result. As a result it was said that whether he used flying ash or "mechanical fans," Hsin-tu never failed in his tests.

Hsin-tu Fang also offered explanations of the phenomena related to the expulsion of ashes from pitchpipes recorded in Ssu-ma Piao's *Hsü Han-chih*. He believed that "if blown free from the pitchpipes by the proper ch'i, the ashes would land close to the mouth of the pipe rather than far away; if moved by breath, the ashes would be scattered in all directions and a bit further [from the mouth of the pipe]." Here, "breath" (*k'ou-ch'i* 口氣) refers to the breath of the person conducting the test. Hsin-tu also explained the observation that "ashes moved by drafts from people's clothes are [found] together" by noting that "if drafts from clothing arose in the chamber, there would be whirlwinds at both ends; the ashes would be moved from the pitchpipes by these whirlwinds, and therefore would [be found] together." In order to avoid untoward influences on the test, Hsin-tu requested that observers "calm their spirits, move in accordance with propriety and avoid carelessness."

Because of the specificity of Hsin-tu Fang's description, the results of his observations created a tremendous surge of interest in a procedure the theoretical foundations of which were fascinating to contemporaries. Supporters of the practice found they had gained real moral support, and gradually the hou-ch'i practice became a part of the lore of the ancients.

After a stable development during the course of the Northern and Southern, Sui, and T'ang dynasties, the hou-ch'i practice became in the Sung dynasty the subject of considerable interest. The most influential or significant of those who wrote on it at this time were Ts'ai Yüan-ting 蔡元定 (1135–98), Shen Kua 沉括 (1030–94), and Chu Hsi 朱熹 (1130–1200). Ts'ai advocated the use of hou-ch'i in obtaining the standard tone.[7] Shen compared hou-ch'i with acupuncture to support his belief in ch'i.[8] Chu employed the analogy of the pitchpipes as

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[6] *Sui-shu*, p. 394.

[7] Ts'ai Yüan-ting, *Lü-lü hsin-shu* 律呂新書 [New book on pitchpipes], in *Ssu-k'u ch'üan-shu,* vol. 212 (Taipei: Shang-wu yin-shu-kuan, 1983), 2: p. 3.

[8] Shen Kua, *Meng-hsi pi-t'an chiao-cheng* 夢溪筆談校正 [Collated and verified writings of Meng Hsi] (Shanghai: Shanghai ku-chi ch'u-pan-she, 1987), 7: p. 325. Analogies between hou-ch'i and acupuncture continued to be made during the Ming dynasty. For instance, T'ao Wang-ling 陶望齡 once wrote "On the winter solstice, the *yang-ch'i* rises to within nine *ts'un* of the ground. Only the *huang-chung* pitchpipe can be reached, therefore only the *huang-chung* pitchpipe responds. Other months correspond with the lengths of the pitchpipes. This resembles the use of acupuncture in the treatment of disease. By probing with needles of different lengths, the ch'i will be

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a proof in his discussion of lutes.[9]

The above discussion should make it clear that in ancient China's learned circles the hou-ch'i practice was generally accepted.

The Appearance of Doubts

Throughout the historical development of the hou-ch'i practice, controversies surrounded every element of the technique. The location of the experiment, the quality of the soil, the selection of materials, the placement of the pitchpipes (bases or tops aligned? buried or not?), the means of filling the pitchpipes with ash (ought the ash to be placed on light silk fabric?) and so forth were all hotly contested. Not only that, there was also a constant production of new ideas. All of this may well have been the inevitable consequence of repeated experimental failures.

The most stridently expressed doubts did not appear until after the midpoint of the Ming dynasty. An unabashed critic, the *li-hsüeh* 理學 scholar Wang T'ing-hsiang 王廷相 (1474–1544), reckoned that "the ch'i of Heaven and Earth rises and falls. . . . If you say, 'The *yang* pitchpipe responds before the summer solstice, and the *yin* pitchpipe responds before the winter solstice,' well, that means that in one year both *yin* and *yang* have risen and neither has fallen!" He therefore concluded that the hou-ch'i practice was nothing but "Tsou Yen's 鄒衍 and Ching Fang's ridiculous talk." Furthermore, he denied the possibility of employing pipes of various lengths to induce ch'i. He declared that "there is no little nook into which ch'i does not penetrate, and it cannot be constrained. Is it possible that ch'i will be constrained within [a pipe of] nine *ts'un*? Is it possible that ch'i will linger in a small space and take a month and more to produce a response?"[10]

Liu Lien 劉濂, a *chin-shih* 進士 and censor of the Cheng-te 正德 period (1506–21), was another important opponent of the hou-ch'i practice. He was particularly critical of Hsin-tu Fang, of whom he once wrote:

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reached." Chang Hsüan 張萱, *Hsi-yüan wen-chien-lu* 西園聞見錄 [Records from the experiences of Hsi-yuan], in *Chung-hua wen-shih ts'ung-shu* 中華文史叢書 [Collectanea of Chinese history and literature], part 5 (Taipei: Ta Chung-kuo t'u-shu kung-ssu, n.d.), 51: p. 20.

[9] Chu Hsi, *Chu-tzu ta-ch'üan* 朱子大全 [Complete works of master Chu], in *Ssu-pu pei-yao* 四部備要 [Essentials of the Ssu-pu] (Taipei: Chung-hua shu-chü, 1965), 66: pp. 30–31.

[10] Wang T'ing-hsiang 王廷相, *Wang T'ing-hsiang chi* 王廷相集 [Collected works of Wang T'ing-hsiang] (Peking: Chung-hua shu-chü, 1989), 40: p. 711.

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> During the Northern Ch'i, Hsin-tu Fang observed the appearance of the clouds. Once, while conversing, he pointed to the sky and said, "The fortnightly period of the early spring has arrived." His interlocutor thereupon checked the pitch-pipes, only to discover that the ashes had already flown free. [Hsin-tu] made a wheel of twenty-four fans and buried it so as to predict the twenty-four fortnightly periods. With the arrival of each fortnightly period, a single fan moved while all the others remained immobile. I say that ch'i was in the earth, [but] it was without form, and pitchpipes had to be used to observe it. If he could detect the arrival of ch'i by observing the appearance of the clouds, why did he bother with pitchpipes and ashes? If fans could be used instead of pitchpipes in observing it, the pitchpipes must be unreliable!

Liu reckoned that if the observation of clouds or "mechanical fans" could be used to detect the arrival of ch'i, continuing to use pitchpipes for hou-ch'i was unnecessary. He went further, condemning Hsin-tu Fang as "a treacherous and cunning person who dared to employ bewitching absurdities to cheat his master and confuse the people: he ought to have been killed!"[11]

Chi Pen 季本, a student of Wang Yang-ming's 王陽明, also criticized the hou-ch'i practice. He believed that "from the *jui-pin* [pitchpipe] on, the ch'i ought to descend, not ascend, as is said. Otherwise, the ch'i of Heaven and Earth would be always rising and never descending!" His argument closely resembled Wang T'ing-hsiang's.[12] He also expressed some doubts based on a topographical approach:

> The shape of the earth has high points and low points, [but] there is no "before" or "after" with ch'i. Does ch'i first come to rest in the low points of the earth, arriving later in the high points? If we follow the practice, when watching for the ethers there is no need to measure the diameters of the pitchpipes, so long as their lengths are proper. As long as the standard note (*chung-sheng* 中聲) was determined, the ch'i always responded.

As to how to determine that standard note, Chi advocated training blind people with perfect pitch for the task.[13]

Hsing Yun-lu 邢雲路, a *chin-shih* of the Wan-li 萬曆 period (1573–1620) who served as Surveillance Commissioner of Shensi 陝西 province, was also profoundly skeptical of the results obtained by Hsin-tu Fang, as well as by Mao

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[11] Liu Lien 劉濂, *Yueh-ching yüan-i* 樂經元義 [The original meaning of the Classic of Music] (1550), 1: pp. 15–16.

[12] Chi Pen's opinions are cited in Chu Tsai-yü's *Yueh-lü ch'üan-shu*. See Chu Tsai-yü 朱載堉, *Yueh-lü ch'üan-shu* 樂律全書 [Complete musical harmonics], in *Ssu-k'u ch'üan-shu* 四庫全書, vol. 213 (Taipei: Shang-wu yin-shu kuan, 1983), 5: p. 31.

[13] The term "standard note" refers to the note produced by the *huang-chung*. As was written in the *Lü-shih ch'un-ch'iu*, "the *huang-chung* note, midway between the turbid and the clear tone, was the foundation of music" (5: p. 7).

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Hsi-ch'eng 毛栖誠 and his son. Hsing argued that "The motion of the fan and the flight of the ashes are both mechanical [matters]. People trigger the mechanics—these are connected to the mouth of the pitchpipe—then, instantly and without fail, the fan starts to move and the ashes fly up. [They] performed these fraudulent maneuvers to fool their masters."[14]

In those days, the Astronomical Bureau sent officials to Shun-t'ien 順天 prefecture every year at the time of the *li-ch'un* 立春 fortnightly period to practice hou-ch'i.[15] Hsing violently attacked what he saw as "deceiving others through dishonest communication" by mere sleight of hand. "Up to now," wrote Hsing, "officials from the Astronomical Bureau have visited Shun-t'ien prefecture during *li-ch'un* and other festivals in order fraudulently to use mechanics to cause ashes to fly. They then tell people: 'The ashes have flown!' and report to their superiors: 'The ashes have flown!' Whom are they cheating? Heaven?"[16]

Hsing Yun-lu was not the only one to complain of the fraud perpetrated by officials charged with astronomical matters. In Chu Yun-ming's 祝允明 *Yeh-chi* 野記 (Notes from a commoner) we find a detailed description: "In the early years of the present dynasty, the officials who dealt with astronomy still practiced hou-ch'i and measured the [length of the] sun's shadow. . . . It is said that later hou-ch'i became a mere formality. By stuffing ash into a hole which was [in fact] the mouth of a tunnel, the officials were able to make the ashes fly up whenever [they liked] by pouring a soup of boiling lime into the other end of the tunnel."[17]

The addition of water to lime produces heat and carbon dioxide. This is the "soup of boiling lime" mentioned above. A secret tunnel dug under the pitchpipes, along with knowledge of a chemical reaction, thus permitted the officials to produce a shower of ashes at will.

With the arrival of Chu Tsai-yü 朱載堉 (1536–1611), criticism of the practice of hou-ch'i reached a new level. Chu, styled Po-ch'in 伯勤, was a sixth generation descendant of the Ming emperor Jen-tsung 仁宗; his father, Hou-wan 厚烷, had inherited the title of Prince Kung of Cheng 鄭恭王, and Chu Tsai-yü, soon after his birth, became the designated heir. Tsai-yü was an avid scholar and specialized in musical harmonics and mathematics.[18] In his *Lü-lü*

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[14] Hsing Yun-lu 邢雲路, *Ku-chin lü-li-k'ao* 古今律曆考 [Investigations of musical harmonics and calendars past and present], in *Ssu-k'u ch'üan-shu*, vol. 787, 33: p. 6.

[15] Li Tung-yang 李東陽 and Shen Shih-hsing 申時行, *Ta-Ming hui-tien* 大明會典 [The comprehensive codes and statutes of the Ming dynasty] (Taipei: Hsin-wen-feng ch'u-pan kung-ssu, 1976), 233: p. 9.

[16] Li Tung-yang and Shen Shih-hsing, *Ta-Ming hui-tien*, 233: p. 9.

[17] Chu Yun-ming 祝允明, *Yeh-chi* 野記 [Notes from a commoner] (1874 edition from the collection of the Academia Sinica), 1. This passage does not appear in Li Shih's *Li-tai hsiao-shih* edition of the same work.

[18] For the biography of Chu Tsai-yü, see Tai Nien-tsu 戴念祖, *Chu Tsai-yü: Ming-tai ti k'o-hsüeh ho i-shu ti chü-hsing* 朱載堉－明代的科學和藝術的巨星 [Chu Tsai-

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ching-i 律呂精義 (Essentials of musical harmonics), Chu asserted that all of this talk of watching for the ethers and flying ashes was unorthodox:

> The hou-ch'i method went unmentioned in the Classics, appearing instead in apocryphal works (*wei* 緯). Hsin-tu Fang's mechanical fans are especially absurd. Mencius said, "It is better to give up books than to place one's complete faith in them." A Confucian's first priority ought to be the investigation of things so as to understand principle thoroughly (*ko-wu ch'iung-li* 格物窮理). But having been unwittingly misled by unfounded statements for a thousand years, investigations have gone to who-knows-where.[19]

Chu also had idiosyncratic opinions about what he saw as superstitious attitudes towards hou-ch'i. An instance of this is the vividly drawn passage below, from Chu's *Lü-hsüeh hsin-shuo* 律學新說 (New studies of musical harmonics):

> The inventors of hou-ch'i were a frivolous lot. . . . Those who have fallen under its spell nowadays truly revere it. Why? One might well ask: "In making a likeness, what does the painter find easy, and what does he find difficult?" And the answer is: "Painting supernatural beings is easy; painting dogs and horses is difficult." Why is this? In making a likeness, one wants there to be a resemblance [to the original]. Since no one can verify [the appearance of] supernatural beings, [painting them] is easy. One can verify [the appearance of] dogs and horses, so [painting them] is difficult. The [case of the] musician who gathers millet to make woodwinds is like that of the dogs and horses, while [the case of] watching for the ethers and verifying the tones is like that of the supernatural beings. Long ago, crazed actors and bewildered blind men invented this unfounded practice in order to confer magical power upon their techniques. They thereby fooled their silly audiences and made it quite impossible for others to question them. All through history they were believed—none doubted. This is making the difficult easy and the easy difficult: is it not ridiculous?[20]

Chu not only criticized the gullibility of earlier scholars confronted with hou-ch'i, he also carried out rigorous experiments himself, driven by a profound scientific spirit. For instance, traditionalists all preferred bamboo from Mount Chin-men 金門山 when it came to making pitchpipes,[21] but after a meticulous analysis, Chu wrote in his *Lü-lü ching-i*:

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yü: A superstar of science and art in the Ming] (Peking: Jen-min ch'u-pan-she, 1985); Ch'en Wan-nai 陳萬鼐, *Chu Tsai-yü yen-chiu* 朱戴堉研究 [Studies of Chu Tsai-yü] (Taipei: Kuo-li ku-kung po-wu-yuan, 1992).

[19] Chu Tsai-yü, *Yueh-lü ch'üan-shu*, 5: p. 40.

[20] Chu Tsai-yü, *Yueh-lü ch'üan-shu*, 22: p. 30.

[21] The use of bamboo from Mount Chin-men in the practice of hou-ch'i became popular no later than the Chin dynasty. During the Ch'ing dynasty, Ma Kuo-han wrote in the afterword to his *Mei-tzu hsin-lun* 梅子新論 [New discourses of master Mei]: "According to *chüan* 42 of the *Yü-lan*, Juan Chi's 阮籍 *I-yang-chi* 宜陽記 is cited to the

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> Mount Chin-men is also known as Pitchpipe Mountain (*lü-kuan shan* 律管山). Nowadays it is located in Yung-ning 永寧 county, in Honan 河南. Although this area produces bamboo, it is only the small bamboo with widely spaced joints that is used—the large bamboo is useless. [In particular,] bamboo with close-set joints which is not round, and bamboo the ends of which are uneven are useless. Sweet bamboo is the best, particularly if its joints are widely spaced. Finding natural pitchpipes, whose inner and outer measurements naturally fit the pattern—that is precious indeed! However, one must first know the correct pattern; only then can one recognize what is suitable and what is not.[22]

Some time later, after many comparative experiments, Chu discovered that the old favorite Mount Chin-men bamboo was inferior to the Nan-pi-kuan 南筆管 bamboo of Yü-hang 餘杭 county, Chekiang province. This is a good example of the sort of perfectionism Chu Tsai-yü brought to his experimental procedures.

The results of Chu's own experiments with hou-ch'i are recorded in his *Lü-lü cheng-lun* 律呂正論 (Unbiased discussions of musical harmonics), which he composed late in life. He wrote:

> In days of old it was said that whenever pitchpipes were made, reed ash from Ho-nei 河内, black millet from Mount Yang-t'ou 羊頭 in Shang-tang 上黨 and bamboo from Mount Chin-men in I-yang 宜陽 were all indispensable. In fact, all of these materials can be easily obtained. The place called Ho-nei lies within my fief. Shang-tang lies to the north, and I-yang, to the south; it is about three or four days travel to either one [from Ho-nei]. In the eighth year of the Wan-li reign, the *keng-ch'eng* 庚辰 year, I ordered my subordinates to collect several tens of thousands of each of the three, specifically, single grains of mature black millet, double grains of small black millet, and bamboo with widely spaced joints. I planted them myself. The millet has come to occupy a *ch'ing* 頃 of land; the bamboo has become a forest. Up to the present time, all of the bamboo and all of the black millet harvested at my manor are the result of those plantings. However, the [quality of the] soil is not adequate, so my harvest has never matched that of the original lands. I once followed Ts'ai Yüan-ting's directions, and buried [pipes] whose finely graduated lengths ranged from five to ten *ts'un*—all in all there were some 384—in rows at varying depths: no ashes were blown free. I am beginning to think that all who believed in that business are morons or blind men.[23]

The above narration makes it clear that not only did Chu give over lands to the large scale cultivation of black millet, reeds and bamboo, he also zealously fol-

effect that the bamboo of Mount Chin-men could be used to make musical pipes. Therefore, Yang Ch'üan and Mei Tzu both cited Juan Chi." (Ma Kuo-han 馬國翰, *Yü-han shan-fang chi-i-shu* 玉函山房輯佚書, 4: pp. 2648–49.) Yang Ch'üan, Juan Chi and Mei Tzu all lived during the Chin dynasty.

[22] Chu Tsai-yü, *Yueh-lü ch'üan-shu*, 5: pp. 1, 11.

[23] Chu Tsai-yü, *Lü-lü cheng-lun* 律呂正論 [Unbiased discussions of musical harmonics] (Wan-li edition from the collection of Academia Sinica), 1: p. 1.

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lowed Ts'ai Yuan-ting's dictum to "cut more bamboo." Between the outer limits of five and ten *ts'un*, he had 384 pitchpipes cut so that the length of each was just slightly greater than its predecessor. All this was in order to perform more precise and complete predictions.

Thus, Chu Tsai-yü's criticism of the hou-ch'i method was solidly founded on the results of his careful measurements and observations. None of his fellow critics—neither those who went before him, nor those who succeeded him—was able to reach the mark that he set.

The Calendar Case of the K'ang-hsi Reign and the Hou-ch'i Debate

Though such Ming intellectuals as Liu Lien, Hsing Yun-lu and Chu Tsai-yü raised their voices in opposition to the hou-ch'i practice, traditional attitudes did not suffer a mortal blow. Only with the introduction of Western learning during the late Ming (1368–1644) and early Ch'ing (1644–1911) did the formerly stable position the practice had maintained in Chinese society become less sure. This was the result both of hou-ch'i being dragged into the debates about the old and new calendrical methods, and of the intervention of officials in the matter.[24]

Johann Adam Schall von Bell (1592–1666; Chinese name T'ang Jo-wang 湯若望) assumed the directorship of China's Astronomical Bureau during the Ming-Ch'ing transition.[25] Beginning in the second year of the Shun-chih 順治 reign (1645), Schall reinstituted the yearly excursion to Shun-t'ien prefecture to watch for the ethers during the five days preceding the onset of the *li-ch'un* 立春 fortnightly period. Perhaps as a proleptic gesture to silence possible mutterings, which could have led to undesirable confrontations, the Jesuit sent an official from the Calendrical Office (Li-k'o 曆科), one from the Clepsydra Office (Lou-k'o-k'o) 漏刻科, and such local officials as timekeepers (ssu-ch'en 司晨) to perform the traditional operations.

However, perhaps because the operations of hou-ch'i were unverifiable, these officials did not normally bother to make actual measurements and instead the timekeeper simply submitted a false report, stating that the ch'i had manifested itself. The day before the arrival of the *li-ch'un* fortnightly period, the

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24 Bodde's "The Chinese Cosmic Magic" fails to make any mention of this.

25 Huang Yi-Long, "T'ang Jo-wang yü Ch'ing-ch'u hsi-li chih cheng-t'ung-hua" 湯若望與清初西曆之正統化 [Adam Schall and the legitimation of the Western calendar in the early Ch'ing], in Wu Chia-li 吳嘉麗 and Yeh Hung-sa 葉鴻灑 (eds.), *Hsin-pien Chung-kuo k'o-chi-shih* 新編中國科技史 [New perspectives on the history of Chinese science and technology] (Taipei: Yin-he wen-hua shih-yeh kung-ssu, 1990), pp. 465–90.

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pitchpipes were put away and a report made to the effect that some or all of the ashes had flown.[26]

These activities surrounding the *li-ch'un* fortnightly period must, as they became customary, have come to be related to the folk customs surrounding the arrival of spring, called "welcoming the spring" (*ying-ch'un* 迎春). In those days, officials and commoners gathered at the time of *li-ch'un* to make preparations for the spring rituals, the ultimate goal of which was the stimulation of agricultural yields. Using earth, they sculpted a "spring ox" (*ch'un-niu* 春牛) and flanking peasant figures (known as *mang-shen* 芒神) who were depicted flailing the ox with whips.[27] The Astronomical Bureau, charged with making the yearly calendar, had the formal responsibility of ensuring the precise timing of *li-ch'un*.

When Adam Schall assumed the directorship of the bureau, he deliberately forced out those astronomers who had been trained in traditional Chinese or Muslim astronomy. However, he had underestimated the tangled intertwining of astronomy and yin-yang numerology. The old methods numerologists had used in telling fortunes were undermined when Schall "changed the sequence of the *tzu* 觜 (λ Orionis) and *shen* 參 (ζ Orionis) constellations," "transposed *lo-hou* 羅睺 (Rahu) and *chi-tu* 計都 (Ketu)" and "obliterated the imaginary *tzu-ch'i* 紫氣 star." The reaction to this was an intense, recriminatory outcry from conservatives.[28] Yang Kuang-hsien 楊光先 (1597–1669), in order to uphold tradition, brought a suit against the Jesuits in 1664—this was the so-called "Calendar Case." In the midst of this conflict, the attitudes of the Catholic astronomers toward hou-ch'i came to be the focus of the attacks of the Chinese conservatives.[29]

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[26] *Man-wen mi-pen-tang* 滿文密本檔 [The archive of secret Manchu memorials], chüan 150, memorial dated the ninth day of the second month of the fourth year of the K'ang-hsi reign (25 March 1665). For a description of this volume, see An Shuang-ch'eng 安雙成, "T'ang Jo-wang an shih-mo" 湯若望案始末 [The beginning and conclusion of the case of Adam Schall], *Li-shih tang-an* 3 (1992), pp. 79–87.

[27] Chuang Chi-fa 莊吉發, "Sui-tz'u i-ch'ou hua ch'un-niu: chien-chieh yuan-ts'ang *Ch'un-niu mang-shen-t'u*" 歲次乙丑話春牛－簡介院藏春牛芒神圖 [On the Spring Ox in the I-ch'ou year: a brief introduction to the Spring Ox and Mang-Shen graph in our museum], *Ku-kung wen-wu yueh-k'an* vol. 2, no. 11 (1985), pp. 49–54; Nakamura Kyō 中村喬, "Ritsushun gyōji fūshū (part one)" 立春行事風習, *Ritsumeikan bungaku* 509 (1988), pp. 434–54.

[28] Huang Yi-Long, "Ch'ing-ch'u ch'in-t'ien-chien chung ko min-tsu t'ien-wen-chia ti ch'üan-li ch'i-fu" 清初欽天監中各民族天文家的權力起伏 [The waxing and waning of the power of various ethnic astronomers in the early Ch'ing Astronomical Bureau], *Hsin shih-hsüeh* vol. 2, no. 2 (1991), pp. 75–108.

[29] Huang Yi-Long, "Ch'ing ch'ien-ch'i tui tsu, shen liang hsiu hsien-hou t'zu-hsu ti cheng-chih" 清前期對觜、參兩宿先後次序的爭執 in Yang Ts'ui-hua 楊翠華 and Huang Yi-Long (eds.), *Chin-tai Chung-kuo k'o-chi-shih lun-chi* 近代中國科技史論集

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In the second month of the fourth year of the K'ang-hsi reign (1665), Yang Kuang-hsien attacked Schall in a memorial to the throne:

> To date, in establishing the calendar, numbers have been used to calculate it, [celestial] phenomena to measure it, clepsydra to verify it, and ch'i to investigate it . . . . Therefore, the Lou-k'o officials undertook an examination, determined the measurement of the clepsydra ought to be one hundred units per day, placed pitchpipes in the hou-ch'i chamber, ascertained the exact moment of the flight of the reed ashes, and employed it to determine whether the predicted time agreed with the naturally occurring moment of the fortnightly periods. . . . Nowadays, [Schall] relies only upon his own calculations and has abolished those offices that used this old system . . . . [When] the pitchpipes used by the Lou-k'o Office are abolished, and no consideration is given to their flying ashes, even if people go so far as to violate the hou-ch'i in its very chamber and celestial aberrations appear, who will dare to speak up? Thus will Schall deceive the whole world in order to present his new method.[30]

Responding to the charges in court, Schall declared that "this business of flying ashes has long been in desuetude, a fact which can be demonstrated by consulting the memorial made by Li T'ien-ching 李天經 under the Ming dynasty. In that memorial, Li accounted for the reed ashes." He also claimed that "[since] the earth is [by turns] hard and yielding, dry and moist, and uneven as well, it is difficult to produce consistent results." This amounted to a confession that Schall himself had never performed hou-ch'i. In addition, he slyly asserted that hou-ch'i actually had nothing to do with the measurement of seasons: its true use was the observation of harvests in certain provinces. However, when Prince K'ang of Ho-shou 和碩康親王 (Giyešu, also known as Chieh-shu 傑淑 or 傑書) (1645–97) asked whether Schall had officially reported this, and why

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[Science and technology in modern China] (Taipei: Chung-yang-yen-chiu-yuan chin-tai-shih yen-chiu-so, 1991), pp. 71–93; idem, "Ch'ing ch'ien-ch'i tui ssu-yü ting-i chi ts'un-fei ti cheng-chih: she-hui t'ien-wen-hsüeh ti ko-an yen-chiu" 清前期對四餘定義及存廢的爭執:社會天文學的個案研究 [The early Ch'ing debates over the definition and existence of the four reminiscences: a case study in the social history of astronomy], *Tzu-jan k'o-hsüeh-shih yen-chiu* vol. 12, no. 3 (1993), pp. 201–10 and vol. 12, no. 4 (1993), pp. 344–54; idem, "Chung-hsi wen-hua tsai Ch'ing-ch'u ti ch'ung-t'u yü t'ou-hsieh: I T'ang Jo-wang so-pien min-li wei ko-an yen-chiu" 中西文化在清初的衝突與妥協－以湯若望所編民曆爲個案研究 [Conflict and compromise between Eastern and Western cultures in the early Ch'ing dynasty: a case study of the popular calendar made by Adam Schall], paper presented at the International Symposium on the Occasion of the 400th Anniversary of the Birth of Johann Adam Schall von Bell, S.J. (1592–1666), St. Augustin, Germany, May 1992.

[30] *Man-wen mi-pen tang*, *chüan* 149, memorial dated the thirteenth day of the first month of the fourth year of the K'ang-hsi reign (27 Feb. 1665); *Man-wen mi-pen tang*, *chüan* 150, memorial dated the ninth day of the second month of the fourth year of the K'ang-hsi reign (25 March 1665).

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he had failed to set up pitchpipes in all fifteen provinces to check the time of their harvests, Schall was at a loss. All he could manage to say was that he was old and sick, and had erred in his earlier testimony.

It had been in order to avoid the familiar accusation that "fortnightly periods calculated in accordance with Western methods are not verifiable through heavenly motions" that Schall had posited a relationship between hou-ch'i and the prediction of harvests. In ancient China it was believed that "when the sages ruled, timely winds came in season; when worthy men were at the court, the eight winds dispersed." As a result, during the fortnightly periods of the two equinoxes, the winter and summer solstices and the four initial fortnightly periods of each season (*ssu-li* 四立), people observed the winds. The varying wind directions enabled them to predict the events of the coming year. This is illustrated in *Ta-Ming t'ien-yüan yü-li hsiang-i t'u-shuo* 大明天元玉曆祥 異圖說 (The illustrated omens in the *T'ien-yüan* calendar of the Ming dynasty) recompiled by Yü Wen-lung 余文龍 under the Hsüan-tsung emperor 宣宗 (r. 1426–36):

> [If] the wind comes from the *ch'ien* 乾 direction, severe frost will lay things waste; [wind] from the *k'an* 坎 direction [means] the year will be very cold, and the northern barbarians will invade; [wind] from the *ken* 艮 direction [means] the year will be bountiful and there will be a full harvest of the five grains; [wind] from the *chen* 震 direction [means] that the ch'i will leak and nothing will come to fruition; [wind] from the *hsün* 巽 direction [means] the year will be windy and many pests will die; [wind] from the *li* 離 direction [means] that drought will harm the animals; [wind] from the *k'un* 坤 direction [means] that cold weather will last into spring, floods will rise in the sixth month, and people will be melancholic; [wind] from the *tui* 兌 direction [means] that wars will break out and frost and cold will produce calamities.[31]

This practice was very similar to the astro-meteorology authorized by the Church. Having protected himself in advance from the attacks of fellow priests, who might have accused him of superstition,[32] Schall sent officials to the observatory to watch for the winds on the fortnightly periods of the two equinoxes,

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[31] Yü Wen-lung 余文龍, *Ta-Ming t'ien-yuan yü-li hsiang-i t'u-shuo* 大明天元玉曆祥異圖說 [The illustrated omens in the *T'ien-yüan* calendar of the Ming dynasty] (Taipei Central Library, rare book no. 6478), 7: pp. 3–4.

[32] Huang Yi-Long, "Yeh-ssu-hui-shih tui Chung-kuo ch'uan-t'ung hsing-chan shu-shu ti t'ai-tu" 耶穌會士對中國傳統星占術數的態度 [Jesuit attitudes toward traditional Chinese astrology and numerology], *Chiu-chou hsüeh-k'an* vol. 4, no. 3 (1991), pp. 5–23. A translation of this paper by Dr. Catherine Jami appeared in the conference volume for the "Temps et espace dans la rencontre de la Chine avec l'Europe aux XVIIe et XVIIIe siècles" conference held in Paris in October 1991.

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two solstices and four seasonal fortnightly periods.[33] However, when Schall had to face an interrogation in court, he unwisely conflated watching for the ethers with watching for the winds and had to admit somewhat embarrassedly that he had perjured himself.

Rather unhappy because of Schall's neglect of hou-ch'i, the regents wrote:

> Ou Chi-wu 歐繼武 (the Erudite in the Clepsydra Office) confesses that "It is a tradition to set up pitchpipes in order to watch for the ethers on *li-ch'un*. [However], all the pipes were collected and put away on the day before *li-ch'un* and reports were made and real measurements never took place." This confession makes it clear that the timing of *li-ch'un* has never been verified. Whenever fortnightly periods are reported, it is important also to report the harvest and condition of people's lives. When the pipes are pulled out early, how can we verify the action of spring ch'i on *li-ch'un*? This matter ought to be thoroughly investigated and reported through memorials.[34]

After a grim interrogation, Schall altered his confession, admitting that though the spring ch'i was determined by celestial phenomena, he had sent officials out to observe the earth's ch'i—quite a different matter. Moreover, Schall stated that the pitchpipes had been pulled one day early because of the presence of ch'i floating in the air, a ch'i neither hot nor cold, which had prompted the officials to declare that the spring ch'i had manifested itself. Obviously this is mere blather. An inspection of the *Hui-tien* 會典 (The comprehensive codes and statutes) shows that there is no statute that justifies the practice of pulling up the pitchpipes the day before *li-ch'un*. Schall was severely reproached because of all this.[35]

Adam Schall was not the only official under whose direction the results of hou-ch'i were falsified. During the period of the Calendar Case, the same practices were perpetuated under Schall's successor, Chang Ch'i-ch'un 張其淳. According to the 1664 calendar, *li-ch'un* fell on the nineteenth day of the twelfth month; the officials sent to Shun-t'ien prefecture pulled out the pitchpipes on the eighteenth day. Not only did Chang fail to report or correct this, he reported that he had personally witnessed the arrival of spring and the removal of the pitchpipes from the earth on the eighteenth day.[36]

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[33] We have seen, for example, a memorial dated 22 June 1645 from the collection of the Beijing Number One Historical Archive recording Schall's orders to astronomical officials to predict the winds on the summer solstice. We are grateful to Mr. An Shuang-ch'eng for providing us with this material.

[34] *Man-wen mi-pen-tang*, *chüan* 150, memorial dated the ninth day of the second month of the fourth year of the K'ang-hsi reign (25 March 1665).

[35] *Man-wen mi-pen-tang*, *chüan* 150, memorial dated the twenty-fourth day of the second month of the fourth year of the K'ang-hsi reign (4 April 1665).

[36] *Man-wen mi-pen-tang*, *chüan* 150, memorial dated the ninth day of the second month of the fourth year of the K'ang-hsi reign (25 March 1665).

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On the first day of the fourth month of the following year (26 April 1665), Minister of Personnel A-ssu-ha 阿思哈 determined which officials had been sent to Shun-t'ien to perform hou-ch'i, and suggested that they be removed from office and judged by the Board of Punishments. Some of the officials involved had already died (e.g., P'an Kuo-hsiang 潘國祥) or been removed from office for other crimes (e.g., Chu Kuang-hsien 朱光顯); the others were all pardoned because of a general amnesty declared on the fifth day of the third month (31 March 1665).[37] The only official who had to face the Board of Punishments was Chang Ch'i-ch'un, who was ultimately pardoned, along with Schall, thanks to the same general amnesty that had saved his fellow conspirators.[38]

The power of the Catholic astronomers was dramatically reduced as a result of Yang Kuang-hsien's accusations. High ranking astronomers were either dismissed or decapitated. After declining the offer several times, Yang accepted the post of director of the Astronomical Bureau in the ninth month of 1665.[39]

Having accused Adam Schall of faking the hou-ch'i calculations, it was now incumbent upon the new director to apply hou-ch'i correctly in measuring the fortnightly periods. This was especially so since the applicability of hou-ch'i

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[37] The combination of a severe earthquake in Peking and the appearance of two comets with tails twenty to thirty degrees long prompted the emperor to declare an amnesty. Huang Yi-Long, "Yeh-ssu-hui-shih T'ang Jo-wang tsai hua en-jung k'ao" 耶穌會士湯若望在華恩榮考 [A study of the imperial honors won by the Jesuit Adam Schall in China], *Chung-kuo wen-hua* 7 (1993). This paper was presented at the International Conference in Honor of the 400th Birthday of Adam Schall and the Introduction of Catholicism into China, Taipei, October 1992.

[38] *Man-wen mi-pen-tang*, *chüan* 152, memorial dated the first day of the fourth month of the fourth year of the K'ang-hsi reign (15 May 1665); chüan 152, memorial dated the twelfth day of the fourth month of the fourth year of the K'ang-hsi reign (26 May 1665). Chang Ch'i-ch'un was demoted to the position of vice director in the eighth month of the same year. This was a result of his failure to report promptly the damage to a concave simplified instrument (*chien-i* 簡儀) that resulted from an earthquake that hit Peking in the third month. Only after reports by Yang Kuang-hsien and the Manchu Director had been submitted did Chang memorialize to request repairs. Thus his demotion and censure for "sloppiness and negligence in handling things." Yang Kuang-hsien 楊光先, *Pu-te-i* 不得已 [I cannot do otherwise], in Wu Hsiang-hsiang 吳湘湘 (ed.), *T'ien-chu-chiao tung-ch'uan wen-hsien hsü-pien* 天主教東傳文獻續編 [Supplement to the Christian documents coming to the East] (Taipei: Hsüeh-sheng shu-chü, 1965), ser. 2, vol. 3, pp. 1255–1300.

[39] Huang Yi-Long, "Tzu-jih chih cheng yü K'ang-hsi li-yü" 擇日之爭與康熙曆獄 [Debates over divination and the K'ang-hsi Calendar Case], *Tsing-hua hsüeh-pao* (New) 2 (1991), pp. 247–80. This article has been translated into Japanese and English. The former, entitled "Takujitsu no arusoi to Kōki rekigoku," 択日の争と康熙暦獄, trans. Itō Takeyuki 伊東貴之, *Chūgoku: shakai to bunka* 6 (1991), pp. 174–203. The latter, under the title "Court Divination and Christianity in the K'ang-hsi Era," has been translated by Nathan Sivin, *Chinese Science* 10 (1991), pp. 1–20.

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had been one of the principal issues in the confrontation between Chinese and Western astronomies. When officials from the Astronomical Bureau were unable to verify the *chung-ch'i* of the twelfth month of 1665 with any precision, Yang Kuang-hsien memorialized that "the hou-ch'i method had long been lost," and asked permission to "search for people whose skill in calculations and making measuring tools for hou-ch'i will enable them to assist your humble subject." He also asked that "the Board of Rites be ordered to secure bamboo tubes from Mount Chin-men in I-yang, black millet from Mount Yang-t'ou in Shang-tang and reeds from Ho-nei."[40] After these materials had been provided him, Yang followed the ancient methods in performing hou-ch'i and personally measured the fortnightly periods—in vain. In time, Yang applied for funds from the Board of Works to have a hou-ch'i chamber built in front of his private residence. Again, he personally attended to the operations of hou-ch'i, and again he was unsuccessful. Nor did his search for hou-ch'i experts produce any results. Under the circumstances, Yang did not dare falsify his results. Ultimately, he was not even able to perform the old hou-ch'i rituals.[41]

All of these failures lent weight to the arguments of Ferdinand Verbiest (1623–88) and others who, by the end of 1668, had begun to undermine the verdict in the Calendar Case. In his *Pu-te-i pien* 不得已辨 (I cannot help rebutting), Verbiest refuted Yang's criticism of the Western methods. When it came to hou-ch'i, Verbiest wrote that "everyone knows that using reed pipes and flying ashes is no way to measure the fortnightly periods. Only Yang did not realize this." As a proof, Verbiest provided four arguments.

> First: on the *ch'un-fen* fortnightly period, the sun intersects the equator. The date is always the same in all countries. The use of flying ashes in watching for the ethers depends on the earth's ch'i, which may be cold or hot, dry or damp. Different as the ch'i of the earth in different countries may be, the timing of the *ch'un-fen* fortnightly period is everywhere the same.

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40 *Ta Ch'ing Sheng-tsu jen-huang-ti shih-lu* 大清聖祖仁皇帝實錄 [Veritable records of the K'ang-hsi emperor] (Peking: Chung-hua shu-chü, 1985), 18: pp. 9–10.

41 Nan Huai-jen 南懷仁 (Ferdinand Verbiest), *Hsi-ch'ao ting-an* 熙朝定案 [Resolved cases of the K'ang-hsi reign] (Vatican Library, ARSI Jap. Sin. II 67), pp. 47, 62–63; idem, *Pu-te-i pien* 不得已辨 [I cannot refrain from disputing], *T'ien-chu-chiao tung-ch'uan wen-hsien hsü-pien*, ser. 1, p. 13. On the various versions of the *Hsi-ch'ao ting-an*, see Willy Vande Walle, "Problems in Dating the Writings of Ferdinand Verbiest: The Astronomica Europea and the Xi-chao ding-an," in Fu-jen Catholic University (comp.), *Nan Huai-jen shih-shih san-pai chou-nien kuo-chi hsüeh-shu t'ao-lun-hui* 南懷仁逝兆三百週年國際學術討論會 [International Conference in Honor of the 300th Anniversary of the Death of Ferdinand Verbiest (1688–1988)], (Taipei: Fu-jen ta-hsüeh ch'u-pan-she, 1987), pp. 237–52; Huang Yi-Long, "K'ang-hsi ch'ao she-chi li-yu ti t'ien-chu-chiao Chung-wen chu-shu k'ao" 康熙朝涉及曆獄的天主教中文著述考 [An investigation of Chinese works by Catholics related to the K'ang-hsi Calendar Case], *Shu-mu chi-k'an* vol. 25, no. 1 (1991), pp. 12–27.

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Second: since the *ch'un-fen* period is determined by the intersection of the sun with the equator, it remains the same for ten thousand years—it is unchanging. The earth's ch'i [on the other hand] is different every year in every country during *ch'un-fen*. If the earth's ch'i is used to calculate *ch'un-fen*, the date will change every year.

Third: *ch'un-fen* is a mere date, and during the period surrounding it the earth's ch'i is more or less the same. It is difficult to differentiate [the fine differences in ch'i]. Moreover, fortnightly periods such as *ch'un-fen* arrive at a specific moment during the day, while the earth's ch'i remains nearly constant throughout the day and is therefore difficult to differentiate. How can one use the earth's ch'i to measure the precise moment of the *ch'un-fen* fortnightly period?

Fourth: [the quality of] the earth's ch'i depends on the earth's contours: it varies depending on proximity to mountains, rivers and lakes. Furthermore, wind, rain, clouds and fog all affect the earth's ch'i. The timing of *ch'un-fen* [on the other hand], depends completely on the intersection of the sun and the equator, which occurs far from the earth. How is this related to the earth? How can one use the earth's mercurial ch'i to measure the unchanging *ch'un-fen*?

A careful examination of this passage shows that Verbiest has criticized hou-ch'i from a rational, scientific perspective. He believes that the earth's ch'i varies depending on where it is found and that is it changeable. Therefore, it is useless in determining the timing of the fortnightly periods.

In the tenth month of 1668, the K'ang-hsi emperor ordered the Board of Rites to determine once and for all whether people who could perform hou-ch'i could be found, and whether Yang Kuang-hsien himself possessed this ability.[42] Clearly, the recently enthroned emperor had grave doubts about Yang's calculations. In Yang's response, a note of embarrassment is quite audible: "Though Ssu-ma Ch'ien's 司馬遷 *Shih-chi* 史記 recorded the size of the pitchpipes, their usage has long been lost. As to the search for people who are capable of performing hou-ch'i, it has produced no one. I myself am ill and incapable of handling [this matter]." The emperor's reply was a reminder that Yang had a responsibility as director of the Astronomical Bureau and ought not to shirk it. He urged his subject to persist in his "search for those people whose skill in calculations would enable them to carry out hou-ch'i."[43]

In the second month of 1669, Yang was dismissed from the Astronomical Bureau. The cited reason was that "having assumed the position of director of

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[42] *Sheng-tsu jen-huang-ti shih-lu*, 27: p. 11. Article dated the *wu-tzu* day of the tenth month of the seventh year of the K'ang-hsi reign (28 Nov. 1668).

[43] *Sheng-tsu jen-huang-ti shih-lu*, 27: p. 18. Article dated the *ping-chen* day of the eleventh month of the seventh year of the K'ang-hsi reign (24 December 1668).

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the Astronomical Bureau, he was unable to correct the errors in the calendar."[44] Shortly before stepping down, Yang noted that there were "three matters I have not been able to bring to completion because of ill health." He requested that his Manchu counterpart, Director Ma-yu 馬祐 of the Astronomical Bureau, present to the court a memorial in which Yang had written that "all these [matters] are official bureau business which, [I,] Kuang-hsien, was unable to complete; they should be clearly reported and assigned to others. Please remove me from office for my negligence so that I may rest and quietly recuperate." Hou-ch'i was the first of the three things mentioned in these memorials: clearly this was one of the foci of the disputes of the time.[45]

On the fifteenth day of the sixth month of the eighth year of the K'ang-hsi reign (12 July 1669), Verbiest was authorized to take over the business of the Astronomical Bureau under the unofficial title of *Chih-li li-fa* 治理曆法 (Orderer of the calendar).[46] On the twenty-ninth day, the Board of Rites memorialized to urge a resolution of the previous hou-ch'i episode in the Astronomical Bureau:

> Nowadays Yang Kuang-hsien has been removed from office; he never found anyone capable of performing hou-ch'i. Moreover, when the Council of Deliberative Officials [earlier] this year made a decision concerning the calendar, Verbiest stated that "the practice of hou-ch'i is traditional; and hou-ch'i and calendrical calculations are not related." Therefore, the practice of hou-ch'i in Shun-t'ien prefecture ought to be abolished. Since hou-ch'i is irrelevant to calendrical calculations, Yang Kuang-hsien's hou-ch'i experiments in other places and his search for hou-ch'i experts should also be abandoned.

The memorial was approved and respectfully followed on the first day of the seventh month (28 July 1669).[47] The long-standing practice of hou-ch'i had been officially proscribed.

Official and Civilian Attitudes towards Hou-ch'i after the K'ang-hsi Calendar Case

Though the verdict of the Calendar Case had been overturned, and Catholic astronomers such as Adam Schall had been vindicated, an attack on the Western methods soon appeared. In his *Chen li yen* 眞曆言 (True words about the cal-

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[44] *Sheng-tsu jen-huang-ti shih-lu*, 28: pp. 8–9. Article dated the *kung-wu* day of the second month of the eighth year of the K'ang-hsi reign (8 March 1669).

[45] Nan Huai-jen, *Hsi-ch'ao ting-an*, pp. 49–50.

[46] Nan Huai-jen, *Hsi-ch'ao ting-an*, pp. 17–18; Huang Yi-long, "Ch'ing-ch'u ch'in-t'ien-chien," pp. 75–108.

[47] Nan Huai-jen, *Hsi-ch'ao ting-an*, pp. 49–50.

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endar) of 1673, a commoner of Wu 吳 county named Yang Ching-nan 楊燝南, claimed that there were errors in the official calculations of the *li-ch'un* and *li-ch'iu* fortnightly periods and the intercalary month.[48] His arguments replicated those used by Yang Kuang-hsien in his polemic against Adam Schall.

Yang Ching-nan was the scion of a line of bookish men which had gone into decline. One of his father's brothers (*t'ang-shu* 堂叔), Yang T'ing-shu 楊廷樞, had been one of the key figures in the Fu-she 復社. During the 1644 Calendar Case, Ching-nan had assisted Yang Kuang-hsien. His attack on the Jesuits can therefore be seen as part of the conflict over the New (Western) and Old (Chinese) calendars.

Having endured the hardships of the earlier case, Verbiest was extremely concerned, alarmed even, about this new development. In responding to the new accusations, his stance was firm and severe: he contended that only the punishment of "this mean person from Chiang-nan" would guarantee that none would follow in his footsteps. Once Verbiest's memorial had been presented, K'ang-hsi ordered the Council of Deliberative Officials to investigate the accusations made in Yang Ching-nan's *Chen-li-yen*. It is worth noting that when K'ang-hsi ordered Ming-chu 明珠—minister of the Board of War—and others to examine this matter, he not only exhorted them to "avoid all prejudice and judge the rights and wrongs of the issue through open verification," he also particularly reminded them that "you are aware that the transmission of the hou-ch'i method of flying ashes ceased long ago and is not reliable."

The new calendar calculated fortnightly periods and the intercalary month by the "fixed fortnightly period" (*ting-ch'i* 定氣) method instead of the traditional "average fortnightly period" (*p'ing-ch'i* 平氣) method. Two results of this were that the number of days in the fortnightly periods varied by one or two days and the intercalary month differed from that which the traditional method would have produced. These changes led to differences in the gods associated with auspicious days. Some popularly produced almanacs and calendars, however, continued to be arranged in accordance with the traditional methods.[49]

When Yang Ching-nan attacked what he called the mistakes in the official calendar, he said that "the *li-ch'un*, *li-ch'iu* and intercalary month and the other fortnightly periods for this year are all erroneous. The almanacs available in the bookstores show this. Each fortnightly period falls either early or late—they are

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[48] For descriptions of this matter, see Nan Huai-jen, *Hsi-ch'ao ting-an* (Vatican Library, R.G. Oriente. III 231), pp. 91–100 (this text appears also in Wu Hsiang-hsiang, ed., *T'ien-chu-chiao tung-ch'uan wen-hsien*; Huang Yi-Long, *Yang Ching-nan tsui-hou i wei shu-kao hsi-fang t'ien-wen-hsüeh ti pao-shou chih-shih-fen-tzu* 楊燝南一最後一位疏告西方天文學的保守知識份子 [Yang Ching-nan: the last conservative intellectual and his attack on Western astronomy], *Han-hsüeh yen-chiu* vol. 9, no. 1 (1991), pp. 229–45.

[49] Huang Yi-Long, "Chung-hsi wen-hua."

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uneven and irregular. Only by means of the flying ashes can the calendrical method and fortnightly periods be illuminated."[50]

For the most part, what Yang knew of calendar-making was from books. He confessed that "according to my own careful analysis of what the books contain, even the sages were transmitters rather than creators. Even the Seven Governors [i.e., the sun, the moon, and the five planets visible to the naked eye] and Four Reminiscences [the imaginary stars rahu, ketu, yueh-pei and tzu-ch'i] have a predictable pattern which can be examined. I have also analyzed the revolution of stars presented in the books, though I have never made use of the armillary sphere to verify the motions of stars. As to the flying ashes, I dare not construct a flying ash chamber in my private residence, and there is no other means to check the evidence." It was no doubt the prohibition on astronomical studies by private scholars that inhibited Yang and kept him from using the armillary sphere or building a "flying ash chamber."[51]

When Yang Ching-nan brought his lawsuit against the Jesuits, the reputation of the Western methods was at its apex. The environment had changed little since Yang Kuang-hsien's pardon in 1669. To make matters worse, Yang Ching-nan's calendrical learning lacked a solid foundation. Despite all of this, he launched his accusations with no more basis than his own firm convictions. This suggests how deeply the belief in hou-ch'i was entrenched in the Chinese mind. Ultimately, Yang Ching-nan was condemned to be flogged one hundred times with a stick, a sentence which was converted to forty lashes with the bamboo and three years in prison; all printed copies of his book and the printing blocks were to be burned.

Based on K'ang-hsi's communications to Ming-chu, we can see that the hou-ch'i method had ceased to hold the high position of "the method of the ancients." But it was not until the Ch'ien-lung 乾隆 reign (1736–95) that the government clearly repudiated the practice. In the introduction to the *Ssu-k'u ch'üan-shu* 四庫全書, the authors—Chi Yun and others—made the following comments on Ts'ai Yüan-ting's *Lü-lü hsin-shu*: "Since hou-ch'i was unreliable and the human voice untestable, what Ts'ai calls the 'standard note' (*sheng-ch'i chih yuan-che* 聲氣之元者) was nothing but flowery language." These writers also criticized Liu Chin's 劉瑾 *Lü-lü ch'eng-shu* 律呂成書 (Book on musical harmonics), stating that "discarding the discernible note to go chasing after the misty, ungraspable ch'i amounts to [chasing] insignificant things."[52]

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[50] Nan Huai-jen, *Hsi-ch'ao ting-an*, p. 95.

[51] *Ch'ing-yuan t'iao-fa shih-lei* 慶元條法事類 [Cases and statutes of the Ch'ing-yuan period] (Peking: Chung-kuo shu-tien, 1948), 17: pp. 20b–21a. From the eleventh century on, private astronomical studies were officially prohibited. This statute was preserved in the legal codes of the Ming and Ch'ing dynasties.

[52] Liu Chin, *Lü-lü ch'eng-shu* in *Ssu-k'u ch'üan-shu*, vol. 212, 2: p. 116.

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Another book that attacked hou-ch'i was *Lü-lü cheng-i hou-pien* 律呂正義後編 (Sequel to the exact meaning of the pitchpipes), compiled during the Ch'ien-long reign. The author stated quite frankly that hou-ch'i was "the mere fabrication of learned men, and does not exist."[53] The arguments mustered by the author are persuasive. For instance, in a passage that criticizes the practice of burying pitchpipes to measure each month's *chung-ch'i* according to the direction of the twelve *ch'en* 辰 (the divisions of the day) the author writes:

> Hou-ch'i is only tested within a chamber. Now that the west of the eastern chamber is the east of the western chamber, there is very little floorspace; if we expect the ch'i to enter a certain pipe, the ch'i must have knowledge; only if the pipe is sentient will it be moved when the ch'i arrives. The notion that the ch'i of the twelve seasons can all be pursued by their bearings is nonsense.

Moreover, when refuting the notion that "with the birth if the first yang, the earth's ch'i ascends," the author referred for the first time to the theory of the earth's sphericity and argued that since the earth was round, the first yang must be born in the center of the earth. He further pointed out that

> the radius [of the earth], from its center to its surface, is 12,000 *li* 里 [6911 km] . . . . If the yang is created on the *hsiao-hsüeh* 小雪 fortnightly period and reaches the surface of the earth during the winter solstice fortnightly period, then the *yang-ch'i* 陽氣 will have moved 12,000 *li* in the space of a month, which is 400 *li* per day, not some small distance. The length of the *huang-chung* pitchpipe is nine *ts'un* 寸 [32.2 cm], while that of the *t'ai-ts'u* pipe is eight *ts'un* [28.6 cm]. The difference is one *ts'un*. If, on the winter solstice, ashes fly from the nine-*ts'un* pitchpipe, the ashes in the eight-*ts'un* pitchpipe should not wait until rainfall (*yü-shui* 雨水) to fly. If all the various pitchpipes can let fly their ashes on the winter solstice, it is not necessary to use the flight of ashes to verify harmonics.

The author points out here that the ch'i which is able to move several hundred *li* in one day cannot possibly trigger the ejection of ashes from but one of a number of pitchpipes only a few *ts'un* in length. The argument resembles that of Wang T'ing-hsiang.

Lü-lü cheng-i hou-pien also contains refutations of those past instances of hou-ch'i's verification.

> The Sagacious Ancestor of the Benevolent Emperor [i.e., K'ang-hsi 康熙] tested it in accordance with the ancient methods—they all failed. Heaven does not change, neither does the *tao* 道. Therefore the *tao* of heaven and earth is con-

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[53] Yun Lu 允祿, Chang Chao 張照, et al., *Lu-lü cheng-i hou-pien* 律呂正義後編 [Sequel to the exact meaning of the pitchpipes] in *Ssu-k'u ch'üan-shu*, vol. 218, 120: pp. 32–39.

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> stant, and there is nothing that was verified in the past that cannot be verified in the present. In the past, the rulers neglected mathematics and harmonics, turned such matters over to officials, and rarely verified them in person. The historical records simply echoed previous documents without realizing their errors. Even if [hou-ch'i] has occasionally been verified, this is not usual. As a result, it is misty and unreliable.

Here the truth or falsity of the hou-ch'i practice is rationally evaluated and K'ang-hsi's unsuccessful tests are mentioned to demonstrate its unverifiability.

Although hou-ch'i had been officially discarded during the K'ang-hsi and Ch'ien-lung reigns, its appeal by no means vanished completely from the popular mentality. For instance, Hu Yen-sheng 胡彥昇, an official who served as magistrate of Ting-t'ao 定陶 county, was a stubborn supporter of hou-ch'i. Hu, styled Chu-hsüan 竹軒, was an expert in music and mathematical harmonics. After his retirement, he set down his thoughts on mathematical harmonics in *Yueh-lü piao-wei* 樂律表微 (An explication of the subtlety of mathematical harmonics), a book which he dedicated to the Ch'ien-lung emperor during a trip the emperor made to south China. In this book, Hu discussed hou-ch'i at length.[54] He contended that "hou-ch'i appeared in the *Yueh-ling chu* 月令注 [Commentary to the monthly ordinance] and its methods were documented in the *Hsü Han-chih* and *Sui-shu* [History of the Sui dynasty]. How can such a thing be 'misty'?"

In response to the comment that in the past hou-ch'i had often proven unverifiable, Hu expressed his belief that this was " [because] the instruments were not sophisticated enough, [because] the calendar had minute errors, or [because] the fortnightly periods were not in harmony." In other words, he believed that if the tests were inconclusive it was either because the procedure or the instruments were faulty, not because of any problem with the theory itself. As to the proper methods, "only the knowledgeable can perform them; only the clever can describe them." The gist of Hu Yen-sheng's text is consistent with the attitudes of those who loyally supported hou-ch'i.

Conclusion

The first concrete description of the hou-ch'i procedure to appear in ancient China was that of Ts'ai Yung 蔡邕 (133–192), in the Eastern Han (25–221 A.D.). It was not, however, until Hsin-tu Fang produced positive results through his mechanical apparatus that hou-ch'i gained a wider acceptance, ultimately

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[54] Hu Yen-sheng 胡彥昇, *Yueh-lü piao-wei* 樂律表微 [An explication of the subtlety of mathematical harmonics], in *Ssu-k'u ch'üan-shu*, vol. 220, 2: pp. 29–43.

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becoming one of the greatest frauds in the history of Chinese science.[55] Despite the consistency with which tests of hou-ch'i failed to lend support to the system, the practice had great appeal because it beautifully united Heaven, Earth and Man even as it forged a relationship between units of measurement, units of mathematical harmonics, earthly statecraft and the heavenly fortnightly periods: people seldom dared to question its validity. Even that great advocate of "investigating things so as to acquire knowledge" (*ko-wu chih-chih* 格物致知), Chu Hsi, and so scientifically puritanical a man as Shen Kua both followed the custom and affirmed its validity.

Between the impossibility of verifying hou-ch'i and people's unwillingness to surrender it, the "loss of ancient methods" came to be used as an excuse and failures came to be attributed to an inability to develop precise enough techniques. People also suggested an analogy between the failure to verify hou-ch'i and improper governance, thereby providing a good explanation for any failures. For instance, the *Li-chi i-shu* 禮記義疏 (Subcommentary to the Records of Rites), written by Hsiung An-sheng 熊安生 during the Chin dynasty (265–420) contains the following passage: "[If the ashes] are slightly moved, the ch'i is in harmony; violent motion means the ruler is weak and the ministers powerful; no movement indicates a severe ruler."[56] Though the Kao emperor of the Sui (598–618) criticized this system as unreliable,[57] Chiao Hung 焦竑 of the Ming still believed in the subtlety of the method and argued that "this practice

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[55] This resembles the fabrications known as *ying-huo shou-hsin* 熒惑守心 (Mars enters the Hsin Constellation) and as *wu-hsing lien-chu* 五星連珠 (the conjunction of the five planets). See Huang Yi-Long, "Hsing-chan, shih-ying yü wei-tsao t'ien-hsiang: i ying-huo shou-hsin wei li" 星占、事應與僞造天象－以熒惑守心爲例 [Astrology, verification and forging celestial phenomena: examples from Mars entering the Hsin Constellation], *Tzu-jan k'o-hsüeh-shih yen-chiu* vol. 10, no. 2 (1991), pp. 120–32; idem, "Five-Planet Conjunctions in Ancient Chinese History," trans. Edward L. Shaughnessy, *Early China* no. 15 (1990), pp. 97–112.

[56] Hsiung An-sheng 熊安生, *Li-chi i-shu* 禮記義疏 [Subcommentary to the Records of Rites], in *Yu-han shan-fang chi-i-shu*, vol. 2, 2: p. 1061.

[57] After the Kao emperor had defeated the Ch'en 陳 dynasty in 589, he sent Mao Shuang 毛爽, Ts'ai Tzu-yüan 蔡子元, and Yü P'u-ming 于普明 to perform hou-ch'i according to the ancient methods. The three men found that the timing of the appearance of ch'i and of the flight of the ashes were different. The emperor then asked Niu Hung 牛弘 about this; Niu's response was: "when half the ashes had flown, that meant harmonious ch'i. When all the ashes had flown, that meant severe ch'i. When none of the ashes had flown, that meant ch'i in decline. When the harmonious ch'i responds, the state is at peace. When the severe ch'i responds, the ministers are indulgent. When the ch'i in decline responds, the ruler is a tyrant." The emperor rejected Niu's conclusions, pointing out that "when the ministers were indulgent and the ruler a tyrant, the state would certainly not be at peace. Given so great a variety of response in the pitchpipes within a single year, is it likely the ruler and ministers can be so changeable?" Niu found it difficult to respond to this. *Sui-shu*, 16: p. 394.

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seems partial and almost false, but its warning to the emperor holds a mirror up [to government]. Therefore, I prefer to believe it."[58]

Wang Wen-ch'ing 王文清 was another advocate of the system:

> The sages used the Way of the Gods (*shen-tao* 神道) to set up education. Therefore the ministers who use the theory of the harmonious ch'i, the severe ch'i and the declining ch'i have to practice it every month to persuade the ruler, while the ruler uses the practice to illuminate his statecraft. This [practice] has attained the standard of Heaven and Earth and must not be doubted on account of minute incidents. There are things under Heaven which can be known but cannot be spoken, which can be doubted but cannot be known.[59]

Ironically, despite the overwhelming number of failures reported by those independent scholars who tried to perform hou-ch'i, official astronomers went on mechanically reproducing the flight of ashes year after year. Their fraudulent practices, performed at the time of *li-ch'un*, had become a tradition no later than the Ming dynasty. The reason for the disappearance of hou-ch'i must no doubt be attributed to the divergence between calendrical calculations and celestial motions, a divergence which engendered a transformation in expectations about and usage of hou-ch'i, from "establishing the correct dimensions of the pitch-pipes" to "measuring the fortnightly periods."

Not until after the midpoint of the Ming dynasty did the scholarly community begin to cast doubt upon hou-ch'i. This was due to both the influence of a flourishing field of mathematical harmonics and the appearance of an ethos of "practical learning" (*shih-hsüeh* 實學).[60] A member of the royal house, Chu Tsai-yü, was the most outspoken critic of hou-ch'i in its long history. To test the validity of hou-ch'i, he followed the ancient methods, and his procedures were scientific. For instance, he carefully chose the black millet, reeds and bamboo he used in his experiments, and his "trial of many lengths of bamboo" method was similar to the trial-and-error method employed in modern experimental science.

Based on the solid foundation of his own experiments, Chu Tsai-yü severely criticized the contradictions to the Confucian dictum *ko-wu chih-chih* that hou-ch'i represented. So deeply planted was hou-ch'i in the minds of the Chinese, however, that Chu's experiments had little influence on society in general, and

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[58] Wang Wen-ch'ing 王文清, *Ku-yueh yuan liu, Yueh-chih-k'ao* 古樂源流, 樂制考 [The origins of ancient music and an investigation of music] (Academia Sinica, manuscript copy), 4: p. 29.

[59] Wang Wen-ch'ing, *Ku-yueh yuan liu, Yueh-chih-k'ao*, 5: p. 28.

[60] Ko Jung-chin 葛榮晉, "Yin-lun" 引論 (Introduction), in Ch'en Ku-ying 陳鼓應, Hsin Kuan-chieh 辛冠潔, and Ko Jung-chin (eds.), *Ming-Ch'ing shih-hsüeh ssu-ch'ao-shih* 明清實學思潮史 [The history of the practical studies trend during the Ming and Ch'ing] vol. 1 (Chi-nan: Ch'i-lu shu-she, 1989), pp. 1–11.

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official astronomers continued to use their mechanical fakery to fabricate results during the *li-ch'un* of each year.

At the beginning of the Ch'ing, the Jesuit Adam Schall assumed the directorship of the Astronomical Bureau. Though he thought hou-ch'i laughable, he concocted false reports of hou-ch'i predictions year after year throughout the twenty years that he held his post. In the early part of the K'ang-hsi reign, Yang Kuang-hsien initiated the Calendar Case, in which Western religion and learning were put on trial. Hou-ch'i was cited as an example of the incommensurability between Western methods and celestial phenomena. Yang took over the Astronomical Bureau when Catholics who had occupied high-ranking positions in the bureau had been removed or executed. When he was obliged to take up the direction of hou-ch'i, his failure opened the way to Verbiest's attacks and the official proscription of hou-ch'i.

Verbiest's refutation of hou-ch'i was entirely rhetorical. Persuasive as it may sound, it was insignificant when compared with earlier criticism based on theoretical concerns. By comparison with Chu Tsai-yü's experimental and theoretical critiques, Verbiest's was far too mild. Despite this, it is a historical reality that Verbiest's criticism led to the formal rejection of the hou-ch'i methods. We can see this as a side effect of Verbiest's vindication of the Jesuit position in the Calendar Case.

While traditional hou-ch'i had nearly evaporated by the end of the K'ang-hsi reign, during the Ch'ien-lung period people like Hu Yen-sheng remained to defend it. Such examples attest to the vitality of the hou-ch'i practice and its persistence in the Chinese mind. Even in a children's book published in 1904 by Yunnan Official Bookstore, hou-ch'i was mentioned: "The first yin is born on the summer solstice, therefore the days become gradually shorter. The first yang is born on the winter solstice, therefore the shadow of the sundial becomes longer. On the winter solstice, the reed ash flies. On *li-ch'iu* 立秋, the leaves of the *wu-t'ung* 梧桐 tree (*Stercelia plalonifoliu*) fall."[61]

Even nowadays, during the waning of the twentieth century, some still attempt rational explanations of the hou-ch'i practice. In an article entitled "Report on a Hou-ch'i Experiment Performed during the Summer Solstice of 1989," Liu Tao-yuan 劉道遠 claimed that his experiments indicated that the correspondence of the ch'i and the flying ashes was a case of physical oscillation related to periodic changes in the gravitational force. Liu's "experiments" are clearly a fabrication.[62]

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[61] Ch'eng Yun-sheng 程允升 and Tsou Sheng-mai 鄒聖脈 (eds.), *Yu-hsüeh ku-shih ch'iung-lin* 幼學故事瓊林 [The jade forest of children's educational stories] (Yun-nan kuan shu-chü, 1904), 1: p. 14.

[62] Liu Tao-yuan's paper was presented at the 1989 Conference on the History of Physics in High School Education, held in Chengdu, Szechuan Province. We are grateful to Mr. Tai Nien-tsu for providing us with this information.

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Despite a conflict between theory and experimental results, hou-ch'i remained an element of the Chinese intellectual experience for two thousand years because men were fascinated by the falsifications of a few charlatans. Truly this is an extraordinary occurrence in the history of science.

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